Foreign acquisition and internal organization*

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Abstract

We study the effect of foreign takeovers on firm organization. Using a comprehensive data set of Portuguese firms and workers spanning two decades, we find that foreign acquisitions lead to: (1) an expansion in the scale of operations; (2) a higher number of hierarchical layers; and (3) higher wage inequality between the top and bottom layers. These results accord with a theory of knowledge-based hierarchies in which foreign takeovers lead to improved productivity, higher demand, or reduced internal communication costs, and thereby induce the acquired firms to reorganize. Evidence from auxiliary survey data reveals that acquired firms are more likely to use information technologies that reduce internal communication costs.

Keywords: Foreign direct investment, internal organization, wage inequality, information technologies.

JEL Classification: D24, E23, F23, M10, M16, O30.

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1 Introduction

Recent theories of knowledge-based hierarchies suggest that the decision of how to organize the acquisition, use, and communication of knowledge is central to understand issues such as the evolution of wage inequality, the growth and productivity of firms, and the gains from international trade (Garicano and Rossi-Hansberg, 2015). Drawing on a comprehensive data set of French manufacturing firms, Caliendo, Monte and Rossi-Hansberg (2015) show that reorganization, through changes in hierarchical layers of workers, is key to understand how firms expand and contract and the evolution of pay in each layer.

While this evidence establishes the basic empirical credibility of organization-based theories, relatively little is known about whether and how different economic or policy shocks can lead to firm reorganization and thereby impact labor market outcomes (Garicano and Rossi-Hansberg, 2015). In this paper, we exploit comprehensive data on Portuguese firms and their workers for the period 1991–2009 to study the effect of foreign takeovers on firm organization and pay structure. The focus on Portugal is well-suited for this purpose: following accession to the European Union in 1986, the country received sizable inflows of foreign investment from higher-income nations, where firms tend to have higher productivity, better management practices and make more extensive use of information technologies.[1]

Our empirical analysis proceeds in several steps. Following Caliendo, Monte and Rossi-Hansberg (2015), we first divide the employees of each firm into four hierarchical layers using occupational categories. Focusing on firms that were domestically-owned in the first year of observation, we then examine if and how foreign takeovers impact their scale of operations, internal organization and wage structure. An important challenge in identifying the effects of foreign acquisitions is selection. If acquired firms constitute a selected subset of the universe of firms that were initially domestic, subsequent heterogeneity in the evolution of firm performance and organization across acquired and non-acquired firms might not be attributable to the change in ownership (Arnold and Javorcik, 2009; Guadalupe, Kuzmina and Thomas, 2012; Hijzen et al., 2013). To mitigate this threat to identification, we follow the leading approach in this literature and examine the effects of foreign acquisitions using a difference-in-differences matching estimator.

We find that foreign acquisitions lead to an increase in sales, labor productivity and average wages, and to an increase in the number of hierarchical layers. The increase in the number of layers occurs for firms that initially had one, two or three hierarchical layers prior to the foreign acquisition. In addition, we find that acquired firms tend to experience a rise in wage inequality between the top and bottom layers, an effect that is particularly pronounced for firms that

[1] Table A1 in the appendix reports that between 1996 and 2009 stocks of foreign direct investment in Portugal grew at an annual rate of 10% per year in real terms, on average. In both 1996 and 2009, the EU and the US accounted for over three quarters of these stocks. The main source countries of foreign investors are Spain, France, United Kingdom, Netherlands, Germany, USA, Switzerland and Luxembourg. Bloom, Sadun and Van Reenen (2012, pp. 194) provide evidence that firms in several of these countries tend to have better people-management practices than firms in Portugal.

had two or three layers before they were acquired. This rise in top-bottom inequality following foreign takeovers appears to reflect, at least in part, changes in observable measures of skill within each layer, notably schooling, experience and tenure.

These empirical results accord well with recent theories of knowledge-based hierarchies (Garicano and Rossi-Hansberg, 2006; Caliendo and Rossi-Hansberg, 2012). In this framework, the realization of output requires both labor and knowledge. More specifically, it requires successful problem solving, which in turn requires sufficient knowledge. Agents who do not know how to solve a problem, also do not know who else might be able to solve it, leading to an optimal pyramidal organization structure consisting of a bottom layer of production workers, and one or more successive layers of managers who specialize in problem solving. Agents are rewarded according to their knowledge, and hence workers in higher layers are rewarded with higher earnings. The value of more layers is to economize on knowledge acquisition in the organization, as fewer agents learn how to solve the more infrequent problems. However, adding more layers is not without costs, since there are communication costs each time a problem is passed from one layer to another. Therefore, the optimal organizational structure depends crucially on the size of communication costs relative to the costs of acquiring knowledge.

Takeovers from investors from higher-income nations can affect optimal firm organization through two different (but not mutually exclusive) channels. First, these acquisitions may lead to an expansion in the scale of production because of improved productivity or higher demand. Firms that expand production beyond a certain level optimally do so by adding layers to their hierarchical organization. Second, these ownership changes may improve management practices and reduce internal communication costs. This leads to an increase in the value of hierarchical organization and therefore to a rise in the optimal number of layers, while also resulting in a larger scale of production. When the number of hierarchical layers increases, be it through improved productivity, higher demand or lower internal communication costs, the optimal distribution of knowledge shifts upwards in the hierarchy, implying not only that more problems are solved, but also that a larger share of problems are solved at the top of the organization. Such a redistribution of knowledge can also result from a reduction of communication costs even if the number of hierarchical layers remains unchanged. Since wages reflect knowledge, an upwards redistribution of knowledge implies, in turn, a higher wage inequality between agents at the top and bottom of the hierarchy.

Although the data available to us do not allow us to fully discriminate between the relative importance of these channels, we provide suggestive evidence that reduced communication costs played some role in driving the observed impacts of foreign ownership. As noted above, there is evidence that firms from higher income countries tend to have superior management practices and make more extensive use of information technologies than firms in Portugal (Bloom, Sadun and Van Reenen, 2012). To examine if foreign acquisitions lead to the adoption of these technologies, we use an auxiliary firm-level longitudinal survey. These data are available for a shorter period (2004-2009), and contain indicators on the utilization of the intranet, the email, and internal networks. Using a similar identification strategy, we find that foreign acquisition

has a positive and strongly significant effect on the use of the intranet. While the small size of this sample recommends caution in drawing strong conclusions from these results, we interpret this evidence as supportive of the hypothesis that foreign takeovers lead to the reduction of internal communication costs.

In addition to the literature cited above, this paper complements and extends several strands of existing research. In a recent related paper, Caliendo et al. (2015) find that Portuguese firms that reorganize and add a management layer experience a rise in quantity based productivity, while also observing a drop in revenue-based productivity. A number of earlier studies provide evidence that foreign acquisitions lead to improvements in residual-based measures of productivity, employment, wages, innovation, and management practices, including important contributions by Griffith (1999), Conyon et al. (2002), Girma and Görg (2007), Almeida (2007), Arnold and Javorcik (2009), Guadalupe, Kuzmina and Thomas (2012), Bloom, Sadun and Van Reenen (2012) and Hijzen et al. (2013). While confirming that several of these outcomes also improve among Portuguese firms following foreign acquisition, we believe that this paper is the first to establish a causal link between foreign takeovers and the internal organization and pay structure of firms. In doing so, this paper also speaks to the literature on the labor market consequences of new information technologies, including Autor, Katz and Kruger (1998), Bresnahan, Brynjolfsson and Hitt (2002), Acemoglu and Autor (2011), Beaudry, Doms and Lewis (2010) and Autor, Dorn and Hanson (2015).

The paper proceeds as follows. Section 2 describes the main data set used in the analysis. Section 3 presents the empirical strategy and results related to the acquisition decision. Section 4 outlines the empirical strategy for examining the impacts of foreign acquisition on the internal organization and pay structure of firms and reports the corresponding results. Section 5 discusses if and how our empirical results can be rationalized in the context of the theory of knowledge-based hierarchies. Section 6 provides additional empirical evidence on one of the specific channels of causation identified by the theory. Section 7 concludes the paper.

2 Data

The empirical analysis in this paper draws mainly on data from *Quadros de Pessoal* for the years 1991 to 2009. This data set is an administrative census that gathers information on firms and their workers for the corporate sector in Portugal. It is collected yearly by the Ministry of Employment and participation is compulsory for every firm with wage earners.[2] Each firm is required to provide information about its attributes and those of each employee. The firm-level records include information on number of employees, industry code, geographical location, and percentage of capital that is owned by foreign investors. In the main analysis, we assume that a firm is foreign-owned if more than 50% of capital is owned by foreign investors.[3]

[2] Data for 2001 were not collected, and hence the analysis excludes this year.

[3] The estimates are robust if we assume that a firm is foreign-owned when more than 10% of capital is owned by foreign investors. Results based on this alternative threshold are available upon request.

The set of worker attributes includes monthly wages (base wage and other components of pay), gender, schooling, nationality, date of starting, occupation, and hours worked. The employee records may also be linked to those of the corresponding employer in each year. The administrative records in *Quadros de Pessoal* are recognized for their high reliability and are used by the Ministry of Employment for checking a firm's compliance with labor law. The records must be made available to every worker in a public place of the establishment, which reduces the likelihood of misreporting.

Following Caliendo, Monte and Rossi-Hansberg (2015), we group employees into four hierarchical layers using detailed information on occupations: CEO and directors, top managers, supervisors, and operators. Table A2 in the Appendix provides a detailed definition of these occupations.

We are interested in examining the effects of foreign acquisitions on firm organization and pay structure. Hence we restrict our attention to firms that were domestically-owned in the first year of observation, and focus on changes from domestic to foreign ownership taking place within the same firm. In doing so, we exclude firms that experienced multiple ownership changes over time, implying that all firms in our sample are firms that either remained domestic or were acquired by foreign owners at some point during the period of analysis. Given our focus on how foreign acquisitions impact the internal organization of the firm, we also exclude from the analysis very small firms; i.e., we drop firm-year observations where the firm has less than 10 employees. We further drop firm-year observations for firms that do not have operators. With these restrictions, we have data on 938 firms that were acquired by foreign investors during the period of analysis.

Using the four groups of occupations reported in Table A2, we build hierarchical layers for each firm-year observation, where layers are labelled from 0 (the bottom layer) to 3 (the top layer in a four-layer firm). Firms that have employment in all four occupation groups will have four hierarchical layers (0, 1, 2 and 3). Firms that only have operators will have only one layer (Layer 0). Firms that have workers in one or two of the other occupational groups (besides operators) will have two or three hierarchical layers, respectively. The occupational composition of the second and third layers (Layer 1 and Layer 2, respectively) may therefore vary across firms. We also compute firm-layer-year averages of earnings, education levels and other observable worker attributes, such as experience and tenure.

Figures 1 and 2 illustrate how foreign acquisitions are distributed over time and across industries, respectively. We observe that there were a sizable number of acquisitions taking place in most years, but with a noticeable peak in 2003. Foreign acquisitions also took place in almost every industry, but with a quite uneven distribution.

[Figure 1 here]
[Figure 2 here]

Table 1 reports descriptive statistics on the full sample used in the estimation. Column (1) reports statistics on firm-year observations with at least 10 employees for firms that were

initially domestically-owned. The other two columns distinguish between firms that remained domestic during the period of analysis (Column (2)) and firms that were eventually acquired by foreign investors (Column (3)). These statistics reveal that firms subject to acquisition tend to be larger, more productive, pay higher average wages, and have a higher number of layers. Notice that these differences reflect both initial heterogeneity in firm attributes among acquired and non-acquired firms, as well as future changes.[4] The statistics reported in Table A3 reveal that, by the end of the sample period, firms in the estimation sample account for 64% of sales, 69.8% of employment and 70.4% of the wage bill of all firms that are in the *Quadros de Pessoal* data set. This table further reveals that, by the end of the sample period, firms in the estimation sample that were acquired by foreign investors accounted for 6.2% of total sales, 4.3% of total employment and 4.6% of the total wage bill.

[Table 1 here]

3 The selection decision

Before turning to the analysis of the effects of foreign acquisition on firm organization and wage structure, we explore the patterns of selection into acquisition. Evidence from several previous studies suggests that foreign investors tend to "cherry pick" the largest and most productive firms in each industry. Below we inspect for evidence on the presence of such selection in our estimation sample.

3.1 Estimation strategy

The likelihood that a firm is acquired by foreign investors can be estimated through a logit model. Let $foreign_{it}$ be an indicator variable that equals 1 if firm i is foreign-owned in year t, and $foreign^*_{it}$ a latent variable whose value determines whether or not the firm will be acquired by foreign investors in that year. We can then write $foreign_{it}$=1$[foreign^*_{it} > 0]$ and:

$$foreign^*_{it} = \beta X_{it-1} + \delta_s + \phi_t + \mu_{it}, \tag{1}$$

where X_{it-1} is a vector of lagged firm attributes (log sales and log labor productivity) that would be expected to influence the probability of acquisition in any given year (conditional on the firm being domestically-owned one year before), and δ_s and ϕ_t are industry and year fixed effects, respectively. We also estimate models with industry-specific time trends to account for the role of idiosyncratic shocks at the industry-level. In all specifications, we cluster the standard errors at the firm-level.

[4] Appendix A3 provides a detailed definition of each variable from *Quadros de Pessoal* used in the empirical analysis.

3.2 Results

Before turning to the regression analysis, we visually inspect for the presence of selection. Figure 3 depicts the distribution of residual log sales (top panel) and residual log labor productivity (bottom panel) for two groups of firms: (i) firms that were taken over by foreign investors during the sample period; and (ii) firms that remained domestically-owned. The residuals remove industry and year dummies from the original distributions of log sales and log labor productivity across the two sets of firms.[5] Inspection of this figure reveals that the distribution of each of these variables for acquired firms lies clearly to the right of those that remain domestic, suggesting that foreign investors tend to target larger and more productive firms within each industry.

[Figure 3 here]

Table 2 reports the estimated coefficients and the corresponding marginal effects (in square brackets) from the logit model for the acquisition decision, as defined in equation (1). The dependent variable is the dummy variable for foreign ownership which is related to either lagged log sales or lagged log labor productivity, each relative to the industry mean. All regressions include industry and year dummies. The regressions in columns (2), (4), (6) and (8) additionally include industry trends that account for industry-specific idiosyncratic shocks.

[Table 2 here]

The results reported in this table provide evidence that larger or more productive firms are more likely to become foreign-owned. The estimates in columns (1) and (2) suggest an increase in lagged log sales is associated with a significantly higher yearly probability of being acquired. Rather than a continuous measure of sales, Columns (3) and (4) include indicator variables for each quartile of log sales. The point estimates suggest that the probability of acquisition is significantly higher in the third and fourth quartiles than in the first quartile. The results in Columns (5)-(8) point to similar patterns of selection when using log labor productivity (and the corresponding dummy indicators for quartiles), instead of log sales. In sum, the evidence presented in this section suggest that larger and more productive firms are more likely to be acquired by foreign investors. In other words, it suggests that foreign investors tend to "cherry pick" the larger and better performing domestic firms within each industry.

4 Effects of foreign ownership on internal organization and pay structure

4.1 Estimation strategy

Our strategy for examining the effect of foreign takeovers on internal organization proceeds in two steps. First, we adopt a difference-in-differences approach to compare changes over time in

[5] The densities are drawn using an Epanechnikov smoothing function with a bandwidth of 0.6.

performance and internal organization across acquired and non-acquired firms. Specifically, we estimate an equation of the form

$$y_{it} = \beta foreign_{it-1} + \gamma_i + \phi_t + \mu_{it}, \tag{2}$$

where i and t index firm and year, respectively; y_{it} is the variable of interest for firm i in year t; $foreign_{it-1}$ is the foreign ownership status of the firm in the previous year; γ_i is a firm fixed effect; ϕ_t is a year effect; and μ_{jt} is the error term. We also estimate models with industry-specific time trends to account for the role of idiosyncratic shocks at the industry-level. In all specifications, we cluster the standard errors at the firm-level.

The firm fixed-effects account for the influence of all observable and unobservable drivers of the acquisition decision that are constant or strongly persistent over time. If heterogeneity in entrepreneurial capability (or productivity) across firms is fixed over time, as in the Melitz (2003) model, this method accounts for the selection patterns documented in the previous section. Hence we can compare the evolution of y_{it} at acquired firms with that in firms that remain in domestic hands.

However, if firm capability evolves over the life cycle (see, e.g., Arkolakis, 2016), this comparison may still be complicated by non-random selection. To address this issue, we adopt the leading approach in the literature (Arnold and Javorcik, 2009; Guadalupe, Kuzmina and Thomas, 2012) and combine difference-in-differences with propensity score matching (DD-PSM). The propensity score is the predicted probability of a firm being acquired by foreign investors as a function of firm attributes observed one year before the treatment occurs. We estimate a single model for the propensity score including all years and industries. We use log sales, sales growth, log labor productivity, number of layers, log hourly wage, and log hourly wage squared as explanatory variables, in addition to industry and year fixed-effects. We match treated firms by year, industry and number of layers, using one-to-one nearest-neighbor matching without replacement and imposing common support. By using DD-PSM we essentially inspect for divergence in the path of y_{it} between acquired firms and matched control firms that had similar observable attributes in the year prior to the acquisition.[6]

Table 3 reports the results from estimation of the propensity score. We use a multivariate logit specification in which foreign acquisition is explained by lagged values of the above-mentioned variables. The results confirm that foreign investors tend to target larger firms. They also indicate that, conditional on size and labor productivity, firms with higher hourly wages are more likely to be acquired. The negative sign of the point estimate on labor productivity reflects the fact that, unlike in Table 2, the logit model includes simultaneously several different (but correlated) observable attributes of firms.[7]

[6] The matching procedure implies that once a treated firm is matched with a control, the latter stays the same throughout the whole sample period.

[7] When lagged values of sales and/or labor earnings are excluded from the selection equation, the coefficient on lagged labor productivity turns positive. Although the variables included in the selection equation tend to be strongly correlated, they may reflect relevant heterogeneity between acquired and non-acquired firms. To

[Table 3 here]

Table 4 reports summary statistics for the matched sample in the year prior to acquisition. Column (1) refers to firms that were always domestically owned during the sample period, while Column (2) refers to firms that were acquired by foreign investors. Columns (3) and (4) report, respectively, the t-statistic and p-value for individual t-tests of difference in means. These statistics reveal that the matching procedure is successful at removing observable differences between domestic and acquired firms in the year prior to acquisition. The individual t-tests typically do not reject the mean equality of observable attributes between domestic and acquired firms in the matched sample. The sole exception refers to lagged hourly wage growth, which is found to be significantly lower among firms acquired by foreign investors. Notice, however, that this variable is observed for a considerably smaller set of firms due to missing data. Since matching is exact by industry, year and number of layers, firms in the treatment and comparison groups have exactly the same number of layers in the year prior to the foreign acquisition.

[Table 4 here]

Table A4 in the Appendix reports results from several additional tests of matching quality. The results provide further evidence that our matching procedure does a good job at removing observable differences between domestic and acquired firms. The individual t-tests and the two-group Hotelling t-square test typically do not reject the mean equality of observable attributes between domestic and acquired firms in the matched sample. Once again, the only exception refers to lagged hourly wage growth, which is found to be significantly larger among non-acquired firms. The very small magnitude of the Pseudo R2 of the logit on the matched data, and the test of joint significance of regressors given by the Chi-square test, confirm the overall quality of the matching procedure.

[Table 5 here]

Table 5 reports summary statistics for the sample of matched firms, i.e., firms that prior to acquisition were similar among a number of key observable attributes. In comparison with Table 1, domestic and acquired firms in the matched sample are clearly more similar along the set of attributes measured. This would be expected since matching seeks to remove initial heterogeneity across firms along a number of observable attributes. Notice, however, that some differences remain, as would also be expected if foreign acquisition were to affect how these variables evolve over time.

4.2 Effects on the scale of operations, labor productivity and average wages

We proceed by examining the effects of foreign acquisitions on several indicators of firm performance. Based on the matched sample of firms, we estimate (2) separately for four different

minimize these differences across acquired and non-acquired firms, we include them simultaneously in the logit model used for estimation of the propensity score.

sub-samples, divided according to the initial number of layers, where "initial" is defined as the year prior to the acquisition.[8] For each outcome of interest, we report the difference-in-differences estimates with and without industry specific time trends. All regressions include year dummies, and the results are presented in Table 6.

Foreign acquisitions lead to a significant expansion in the scale of operations, as measured by log sales, for firms with initially two or three hierarchical layers. The estimated coefficients for the other two subgroup of firms (with initially one or four layers) are also positive, but much less precisely estimated. Notice, though, that firms with initially two or three layers account for the vast majority of observations in the matched sample. Table A5 reports analogous estimates for the effects of foreign acquisitions on employment levels, which point to broadly similar conclusions.

[Table 6 here]

The effects of foreign acquisitions on labor productivity are similar to the effects on sales, with positive and significant coefficients for firms with initially two or three layers. The positive effects for these categories of firms are consistent with the fact that the effects on log sales are larger than the effects on log employment (cf. Table A5), implying that labor productivity (measured as the ratio of log sales to log employment) clearly increases following acquisition.

The final two columns in Table 6 show that hourly wages also rise as a result of a foreign acquisition, notably for firms with at least two initial layers. A comparison of the point estimates across the different subgroups of firms also reveal that the magnitude of the average wage response to a foreign takeover tends to increase with the initial number of layers.

In Table A6 in the Appendix we also report equivalent estimates based on pooled regressions (i.e., where we do not condition on the initial number of layers), using both the full and the matched sample. Irrespective of which sample we use, and regardless of whether we include industry-specific time trends or not, foreign acquisitions lead to a significant increase in sales, labor productivity and average wages. In our most preferred specification (based on the matched sample with industry-specific trends), a foreign acquisition increases these three variables by 29, 15 and 7 percent, respectively.

4.3 Effects on internal organization and pay structure

Our main interest lies in opening the "black box" of the firm and explore whether foreign takeovers also affect the internal organization and pay structure of firms.

4.3.1 Number of layers

We start out by estimating (2) for each subgroup of firms, using the number of hierarchical layers, as defined in Section 2, as the dependent variable. The resulting estimates, which are

[8] Notice that the definition of "initial" is equal for treated and untreated firms. This follows from the previously described matching procedure, where the treated and untreated firms in each matched pair have the same number of layers in the year prior to the foreign acquisition.

presented in Table 7, reveal that acquired firms with initially one or two layers tend to experience a significant and strong increase in the number of hierarchical layers of employees, compared with firms that remain on domestic hands. For both categories of firms, the point estimate is close to 0.2, which suggests that roughly 20 percent of the acquired firms add an extra layer to their hierarchies, relative to comparable domestic firms, as a result of the foreign takeover. For firms with initially three layers, the point estimate is also positive, but much smaller and less precisely estimated, though still (weakly) statistically significant. In the final subgroup, consisting of firms with four initial layers, there is no indication that foreign acquisitions affect the hierarchical structure differently for acquired firms than for comparable firms that remain domestically owned. The differential effects across different groups of firms appear to be quite intuitive, with significantly positive effects for the type of firms with a larger scope for adding layers to their organization (i.e., firms with initially one or two layers, and, to a lesser degree, firms with initially three layers).

[Table 7 here]

4.3.2 Layer-level wages

We proceed by examining the effects of foreign takeovers on the pay structure of firms. The results reported in Table 6 suggest that average wages go up following acquisition. But this leaves open the possibility that wages evolve differently across layers within acquired firms. These layer-level wage effects can in principle occur through two different channels: (i) a direct effect of foreign ownership for a given organizational structure (or a given evolution of the organizational structure); and (ii) an indirect effect through the changes in organizational structure induced by the foreign acquisition. The estimates in Tables 8-10 seek to distinguish between these two channels.

In Table 8 we examine how foreign acquisitions impact average hourly wages of different layers in firms that keep the same organizational structure. For each sub-sample of firms (defined according to the initial number of layers) we estimate a set of equations similar to (2), but where the dependent variable is the average wage in Layer x in a z-layer firm, where z is the initial number of layers. This implies that, for each sub-sample, we compare the wage level in a given layer of an acquired firm with the equivalent layer of domestic firms that keep the same organizational structure over time since the foreign acquisition. Using Mincerian wage equations at the firm-layer level, we further decompose these wage effects into a component due to observable worker characteristics (education, tenure and experience) and residual wages.

[Table 8 here]

The results in columns (1) and (2) of Table 8 reveal that, for firms that keep the organizational structure constant, there are no significant effects of foreign acquisition on wages in any layer for firms with initially one or two layers. However, for firms with initially three layers, foreign

acquisition leads to a significant wage increase in the top layer (Layer 2). This rise is mainly driven by residual wages (columns (3) to (6)). On the other hand, for the last subsample, consisting of firms with initially four layers, foreign acquisition leads to a significant wage increase throughout the organization, and particularly in the bottom part of the hierarchy (in Layers 0 to 2). Once again, these wage effects reflect mainly changes in residual wages. Overall, these results suggest that the effects of foreign acquisition on layer-level wages seem to depend, to a considerable degree, on the initial number of layers in the firm.[9]

For the wage effects reported in Table 8, identification is based on firms that keep the organizational structure constant over time. In Table 9, by contrast, we report estimates of how foreign acquisition affects wages in the pre-existing layers of firms that add (one or more) layers to their organization after being acquired. These are estimates from a set of regressions similar to (2), but where the dependent variable is the average wage in Layer $x \leq z$ in a firm with z layers before acquisition and more than z layers after acquisition.[10] The reported estimates in column (2) of Table 9 show that there are no significant effects of foreign ownership for the group of firms that added layers to their organization after acquisition. Notice, however, that the control group consists of non-acquired firms that underwent a similar restructuring process (i.e., adding layers) in the period after the acquisition of their matched counterparts.

[Table 9 here]

The reported estimates in Tables 8 and 9 are layer-level wage effects of foreign acquisition when keeping the (evolution of the) organizational structure constant, where both treated and control firms either add layers (Table 9) or not (Table 8) in the period after acquisition. These are therefore *direct* effects of foreign acquisition, as defined above. In other words, these are effects that are caused directly by the acquisition and not indirectly by the fact that acquired firms evolve differently (in terms of organization) from non-acquired firms after the acquisition. As shown by Tables 8 and 9, we find significant effects of this kind only for 3- and 4-layer firms that keep their organizational structure constant in the years after acquisition.

However, recall that the results in Table 7 reveal that foreign acquisitions lead to an increase in the number of layers, especially among firms that initially had one or two layers. It is therefore plausible that these organizational changes induced by foreign ownership are accompanied by differential impacts on wages across layers. To preserve comparability across treated and control firms, we test for the presence of such wage effects only in the top and bottom layers of the firm. The bottom layer has always the same occupational composition and hence is comparable across firms irrespective or their organizational structure, and the top layer is also conceptually comparable across firms with different number of layers. Thus, we run another set of regressions

[9] Notice that there tends to be a somewhat larger prevalence of missing wage observations higher up in a firm's hierarchy, implying that the estimated wage effect in Layer $x+1$ tends to be based on slightly fewer observations then the equivalent effect in Layer x. As a robustness check we have re-estimated the wage effects using only firms for which we have wage observations in all layers. The results are practically identical and are available upon request.

[10] By definition, these effects can only be estimated for firms with one, two or three initial layers.

similar to (2), for each subsample of firms, where the dependent variable is the average hourly wage in, respectively, the top and bottom layer of a firm.[11] In the regressions where we use the average wage in the top layer as the dependent variable, we are able to capture effects directly related to wages paid in layers that are added to the organization as a result of the acquisition. For example, if a foreign acquisition leads to the addition of another layer of workers who are paid higher wages than workers in pre-existing layers, this will increase the average wage in the firm as a result of the acquisition, all else equal.

[Table 10 here]

The results are reported in Table 10. As before, we distinguish between overall wage effects (columns (1) and (2)), a component due to observable worker characteristics (columns (3) and (4)), and residual wages (columns (5) and (6)). We see that foreign acquisitions lead to a significantly positive (and quite strong) effect on top-layer wages in firms with initially two and three layers. These positive wage effects reflect in part positive changes in the component due to education, tenure and experience of workers, notably among firms with initially two layers. The estimated coefficient in columns (1) and (2) is also positive and of similar size for firms with initially one layer. Although the overall wage effect is not statistically significant, there is a significant positive increase in the component due to worker characteristics (columns (3) and (4)) among this subgroup of firms. For firms with initially four layers, the point estimate in columns (1) and (2) is closer to zero and much less precisely estimated.

On the other hand, regarding wage effects in the bottom layer, we only find significant effects for firms with initially four layers. For the other types of firms, the point estimates are statistically insignificant and also very small in magnitude.

Taken together, Tables 8-10, when seen in conjunction with Tables 6-7, paint a relatively clear and consistent picture, particularly for firms with initially two or three layers, which constitute the vast majority of the firms in our matched sample. We know from Table 6 that these firms (with initially two or three layers) experience an overall increase in sales, productivity and wages as a result of foreign acquisition. And from Table 7 we know that firms with initially two layers also experience a pronounced increase in the number of layers, whereas firms with initially three layers are more likely to keep the same number of layers. How are these effects reflected in layer-level wage responses?

Among the firms with initially two layers, there are no effects on layer-level wages for firms that keep the same organizational structure after being acquired (Table 8). There are also no effects on wages in pre-existing layers for firms that added layers after the acquisition, when compared with similarly re-structured domestic firms (Table 9). In other words, there are no direct wage effects of foreign acquisition when keeping the (evolution of the) organizational structure constant. However, Table 10 shows a significant and strong effect on top-layer wages. When seen in conjunction, this means that the wage effect of foreign acquisition in firms with

[11] The top layer is defined as Layer 0 for 1-layer firms, Layer 1 for 2-layer firms, Layer 2 for 3-layer firms, and Layer 3 for 4-layer firms.

initially two layers can almost entirely be attributed to the fact that some of these firms added a new top layer (with higher wages than in pre-existing layers) as a result of the acquisition. Thus, for these firms, the wage effect of foreign acquisition is predominantly caused by the fact that acquired firms change their organizational structure (add layers) to a larger extent than non-acquired firms.

For firms with initially three layers, there is a much smaller (and only weakly significant) increase in the number of layers after foreign acquisition (Table 7). For this category of firms, foreign acquisition leads to a significant wage increase in Layer 2, which is the pre-existing top layer, for those firms that keep the same organization after acquisition (Table 8). If we estimate the wage effect in the top layer of these firms, which is not necessarily Layer 2 in years after the acquisition, we find a significant wage increase (Table 10) that is even larger (by approximately one third) than the estimated effect reported in Table 8. Taken together, this shows that, for firms with initially three layers, the increase in top-layer wages caused by foreign acquisition is to a large extent caused by a wage increase in the existing top layer at the point of acquisition (Layer 2), which remains, for a large share of these firms, the top layer also in the years after the acquisition. Thus, in contrast to firms with initially two layers, the top-layer wage increase is to a lesser extent related to changes in the organizational structure induced by the acquisition.

For firms with initially one layer, the pattern appears somewhat similar to that observed in firms with initially two layers. These firms also experience an increase in the number of layers as a result of foreign acquisition, which does not lead to higher wages in firms that keep the same organizational structure. However, there are some indications that the addition of layers leads to higher top-layer wages as a result of the acquisition, although the effect is not very precisely estimated. Keep in mind, though, that the number of firms in this category is relatively low. Notice also that the estimated effects of foreign acquisition on sales, labor productivity and average wage are not statistically significant for this subgroup of firms, although all the three point estimates have a positive sign.

For the last category of firms, with initially four layers, the picture is somewhat different. As for firms with initially three layers, these firms tend to maintain the number of layers to the same extent as comparable domestic firms, after being acquired by foreign investors, and tend to experience an increase in average wages as a result of the takeover. However, in contrast to the firms with initially three layers, significant wage increases tend to occur foremostly in the bottom part of the hierarchy. However, when interpreting these results, we should keep in mind that this is by far the smallest subgroup of firms, constituting less than 8 percent of the firms in the matched sample.

The results in Table 10 suggest that foreign acquisition affects internal wage inequality between workers at the top and at the bottom of the hierarchy, at least for the main subgroups of firms. We test this directly by estimating a version of (2), for each subsample of firms, where the dependent variable is the difference in average wages between the top and bottom layer of

the firm.[12] The results are reported in columns (1) and (2) of Table 11. We see that foreign acquisition leads to a significant increase in top-bottom wage inequality for firms with initially two or three layers. This effect is particularly pronounced for firms with initially two layers, with a highly significant increase in top-bottom wage inequality of almost 16%. As previously explained, this is predominantly caused by the addition of a new top layer with higher wages than in pre-existing layers. In columns (3) to (6) of Table 11, we further see that firms that initially had one or two layers (which, as shown above, are more likely to add layers following the foreign acquisition) also tend to experience an increase in top-bottom inequality in the component of wages due to observed worker attributes.

[Table 11 here]

In order to gain even further insight on the wage effects of foreign acquisitions, we have also estimated the effects of foreign ownership on wages averaged across all "managerial layers" (i.e., Layers 1-3). The results, shown in Table B1 in the Online Appendix, show subsample effects of foreign acquisition on average managerial wages that are not statistically significant, though the point estimates tend to be somewhat larger than for average wages in the bottom layer (cf. Table 10). These results provide further confirmation that the overall positive wage effects of foreign acquisitions are to a large extent driven by wage increases at the top layer of the organization.

4.3.3 Normalized hours

In order to complete our characterization of the effects of foreign acquisition on internal organization, we also examine potential changes in the relative size of the different layers, as measured by *normalized hours*. The normalized hours in Layer x is defined as the total number of hours worked in this layer relative to the total number of hours worked in the top layer. Thus, by definition, this measure only applies to layers below the top layer.

In Table 12 we report results for the effects of foreign acquisition on normalized hours based on specifications that are completely equivalent to the ones that produce the wage effects reported in Tables 8-10.[13] In columns (1)-(2) we restrict attention to firms that keep the same organizational structure after acquisition (cf. Table 8). For these firms, we estimate the effects on normalized hours (in layers below the top layer) for firms with initially two, three or four layers. In columns (3)-(4) we consider firms that increase the number of layers after acquisition (cf. Table 9), with effects on normalized hours (in pre-existing layers) estimated for firms with initially one, two or three layers.[14] Finally, in columns (5)-(6), we estimate the effect of foreign acquisition on normalized hours in the bottom layer, for each of the four subgroups of firms,

[12] For firms with only one layer, this difference is, by definition, zero.

[13] Because of missing observations on hours worked that are more prevalent in higher levels of the firm hierarchy, our measures of normalized hours are subject to some degree of measurement error. However, this is not likely to affect the difference in normalized hours between acquired and non-acquired firms, as long as the prevalence of missing observations is not systematically related to ownership status.

[14] For firms with initially one layer, identification is based on firm-year observations in which the firm has more than one layer.

when we allow for indirect effects through differences in the extent of organizational restructuring between acquired and non-acquired firms (cf. Table 10).

[Table 12 here]

The estimated results show hardly any statistically significant effects of foreign acquisition on normalized hours by layer. Thus, whether acquired firms restructured or not, the relative sizes of layers below the top layer do not tend to evolve differently for acquired and non-acquired firms. The only exception is for firms with initially one layer, where foreign acquisitions lead to a (weakly) significantly positive effect on the relative size of the bottom layer (for those acquired firms that add layers), regardless of whether the basis of comparison is the non-acquired firms that also add layers (columns (3)-(4)) or all non-acquired firms (columns (5)-(6)). Overall, though, the results from Table 12 indicate that the increase in employment resulting from foreign acquisition, as shown in Table A5, appears to be proportionally distributed throughout the organization.

4.4 Foreign versus domestic acquisitions

Finally, we explore whether the above reported foreign ownership effects are present also when considering the reverse type of ownership change – when previously foreign-owned firms are acquired by domestic owners. In our data we identify 349 firms which had foreign ownership in the first year of observation and which were subsequently acquired by domestic investors during the period of analysis. After constructing a sample consisting of these firms along with firms that had either domestic or foreign ownership throughout the entire period, we estimate equation (2) using the same set of dependent variables as those reported in Tables 6-9. In these estimations we use two alternative control groups: firms that were always domestic or always foreign. The results are reported in Tables B2.1 to B3.2 in the Online Appendix and show that, when identifying ownership effects only through changes of ownership from foreign to domestic hands, foreign ownership has few systematic significant effects on sales, employment, labor productivity, wages and number of hierarchical layers.

Two conclusions can be drawn from these results. First, the previously reported results in this section are related to *type of ownership* and do not seem to be the effects of acquisitions *per se*. Second, foreign ownership seems to have *persistent* effects. The latter conclusion is based on the fact that ownership effects do not appear to be symmetric. In other words, foreign ownership implies changes in the scale of operations, labor productivity, wages and internal organization of the firm, but these effects only apply to firms that were initially owned by domestic investors. They tend not to be reverted if ownership is subsequently transferred from foreign to domestic hands.

5 Discussion

How can our empirical results be rationalized? Clearly, there are several possible (and not mutually exclusive) explanations. In this section we present a discussion of potential explanations for some of our key results within the context of recently developed theories of knowledge hierarchies, which allows us to identify potential mechanisms that could create a link between foreign acquisitions and the internal organization and wage structure of firms.

5.1 A theory of knowledge hierarchies

The theory of firms as knowledge hierarchies has been developed by Garicano (2000) and Garicano and Rossi-Hansberg (2004, 2006), and further extended by Caliendo and Rossi-Hansberg (2012). Here we will briefly present the main ingredients of the theory, as laid out by Garicano and Rossi-Hansberg (2006).[15]

The starting point is that production requires both labor and knowledge. More specifically, the realization of output requires successful problem solving, which in turn requires sufficient knowledge. This is modeled as agents (workers) drawing one problem per unit of time, where output is one if the problem is solved and zero otherwise. However, some problems occur more often than others. If we rank problems according to their likelihood of occurring, problem z is characterized by a density function $f(z)$ and a corresponding cumulative distribution function $F(z)$, where $f'(z) < 0$. A problem can be solved by an agent who has enough knowledge. Assuming that knowledge is cumulative, i.e., knowledge $\widehat{z}$ implies that all problems $z \in [0, \widehat{z}]$ can be solved, the proportion of all problems an agent with knowledge $\widehat{z}$ can solve is given by $q := F(\widehat{z})$. An agent that encounters a problem that he does not know how to solve, can ask a more knowledgeable agent for help in solving the problem. However, each time a problem is passed from one agent to another, there is a communication cost of $h < 1$ units of time incurred.

A key assumption of the theory is that an agent who does not know how to solve a problem also does not know who else might be able to solve it. Under this assumption, the optimal organizational structure is a knowledge hierarchy consisting of a bottom layer of production workers and one or more successive layers of managers who specialize in problem solving. The amount of knowledge increases as we move up in the hierarchical structure. Thus, production workers learn to solve the most common problems, whereas agents in higher layers in addition learn how to solve more exceptional problems. In each layer, unsolved problems are passed on to the next layer until the problem is solved or until it reaches the top layer. Furthermore, the hierarchy has a pyramidal shape, where higher layers become successively smaller. In equilibrium, agents are rewarded according to their knowledge, which implies that wages are higher for agents working in higher layers of the organization.[16]

[15] See also Garicano and Rossi-Hansberg (2015) for an overview of different variations of this modelling framework.

[16] These general characteristics of the optimal organizational structure are similar if agents are *ex ante* identical, as in Garicano (2000) or Caliendo and Rossi-Hansberg (2012), or if they are *ex ante* heterogeneous, as in Garicano and Rossi-Hansberg (2006). The optimal structure is also qualitatively similar even if knowledge is not cumulative,

When designing the optimal organizational structure, the firm has to decide on the number and size of layers, and on the required knowledge of agents in each layer. Suppose that a firm has L layers with n_0 production workers (the number of agents in Layer 0) with knowledge q_0 and $L-1$ layers of problem solvers (managers), where the knowledge of managers in Layer i is q_i. This implies that the number of problems passed on to Layer 1 is $n_0(1-q_0)$. Since it takes h units of time to communicate each problem, the number of managers in Layer 1 needed to deal with the problems passed on from Layer 0 is $n_1 = hn_0(1-q_0)$. More generally, the size of Layer i is $n_i = hn_0(1-q_{i-1})$. Thus, it is easy to see that $q_0 < q_1 < ... < q_L$ implies $n_0 > n_1 > ... > n_L$.

The value of more layers is to economize on knowledge acquisition in the organization. Since not all problems occur with the same frequency, it is more efficient that fewer agents learn how to solve the more infrequent problems. By adding layers in a knowledge hierarchy, the more knowledgeable problem solvers can be shielded from having to deal with simple (and frequently occurring) problems and can concentrate on solving the harder (and rarer) problems, which increases the value of acquiring knowledge. However, adding more layers is not without costs, since there are communication costs each time a problem is passed from one layer to another. Thus, the optimal organizational structure depends crucially on the size of communication costs relative to the costs of acquiring knowledge.

5.2 Foreign acquisition and firm reorganization

How can foreign ownership affect optimal firm (re)organization in the context of the theory presented above? In principle, there are two different (but not mutually exclusive) channels through which foreign ownership could have an effect, and we will argue that the expected effects through both channels are consistent with some of the key results of our empirical analysis.

First, foreign ownership might directly lead to an expansion in the scale of production because of improved productivity (for example through investments in machinery and new technology) or because of higher demand (for example through product quality upgrading or better access to export markets through integration of acquired plants into the foreign parent company's production and distribution network).[17] In turn, this is likely to increase the number of hierarchical layers for at least some of the firms that increase their scale of production. As shown by Caliendo and Rossi-Hansberg (2012), firms that expand beyond a certain level optimally do so by adding layers to their hierarchical organization. This theoretical prediction is also empirically confirmed by Caliendo et al. (2015), using data on French manufacturing firms.

Second, foreign ownership might also lead to changes in the optimal hierarchical structure for a given scale of production. One of the common explanations in the literature regarding the positive productivity effects of foreign acquisitions is that such a takeover also implies the transfer of new (and better) management practices to the acquired firm (see, e.g., Bloom, Sadun and Van

as in Caliendo and Rossi-Hansberg (2012).

[17] Evidence of such foreign ownership effects is found by Arnold and Javorcik (2009), Guadalupe, Kuzmina and Thomas (2012) and Ge, Lai and Zhu (2015), respectively for Indonesian, Spanish and Chinese firms.

Reenen, 2012). A key element of good management practice is to secure efficient communication and information flows within the organization. Improvement in management practices along this dimension will reduce the cost of communication, as measured by h in the theoretical model. A reduction in h implies that more problems can be communicated per unit of time, which increases the productivity of problem solvers. Thus, for a given number of hierarchical layers, an optimal response to a reduction in communication costs is to let a larger share of problems be solved by agents in the managerial layer(s), which implies an upwards redistribution of knowledge in the organization. Furthermore, since the optimal number of layers is, all else equal, determined by a trade-off between economizing on knowledge acquisition (increasing the number of layers) and economizing on total communication costs within the organization (reducing the number of layers), a reduction of communication costs will also increase the value of hierarchical organization and therefore (weakly) increase the optimal number of layers. Notice here that a reduction of communication costs also leads to higher productivity and a larger scale of production. The reason is that a larger number of problems are communicated per unit of time, which in turn implies that a larger share of problems are solved. This reduces the marginal cost of production for a given hierarchical structure, and even more so if the firm is optimally reorganized by the addition of one or more extra managerial layers.

If the number of hierarchical layers increases, be it through an incentive to increase the scale of production or through a reduction of internal communication costs, the optimal distribution of knowledge shifts upwards in the hierarchy, implying that a larger share of problems are solved at the top (relative to the bottom) of the organization. As previously explained, a reduction in communication costs will have a similar effect even if the number of layers remains unchanged. Since wages reflect knowledge, such an upwards redistribution of knowledge will, in turn, imply a larger wage inequality between agents at the top and bottom of the hierarchy. Thus, our two key results, that foreign ownership leads to (i) a higher number of hierarchical layers and (ii) an increase in wage inequality between the top and the bottom of the organization, are consistent with both of the two above suggested links between foreign ownership and internal organization. Furthermore, a larger scale of production will be the outcome in both cases.

While it is hard to pinpoint the exact channel(s) through which foreign ownership affects the acquired firms' internal organization and wage structure, the positive correlations between foreign ownership and each of the above-mentioned variables suggest that the model of knowledge hierarchies is a relevant theoretical framework for understanding our findings. This applies in particular to our results for the sub-sample of firms with two and three hierarchical layers at the time of foreign acquisition, where we find that foreign ownership is associated with a larger scale of production and a higher top-bottom wage inequality.[18] The main difference between these two categories of firms is that, for firms with initially two layers, foreign acquisition leads to a strong and significant increase in the number of layers, whereas, for firms with initially three layers, the effect of a foreign takeover on the number of layers is much smaller and only weakly significant.

[18] These firms constitute the vast majority (close to 80%) of the total number of foreign acquisitions in our matched sample.

However, notice that both of these patterns are consistent with an explanation whereby foreign acquisition leads to lower internal communication costs. In both cases, knowledge is redistributed towards the top of the organization, resulting in a higher top-bottom wage inequality. But the two types of firms tend do this in different ways. Whereas the firms with initially two layers tend to add a new top layer with higher wages, the firms with initially three layers tend to keep the same number of layers but instead increase wages in the existing top layer of the organization.

Finally, each of our suggested possible mechanisms for the effect of foreign acquisition on internal pay structure, whether it works through firm reorganization or not, relies on a redistribution of knowledge internally in the acquired firms. Indeed, our estimates do provide some evidence that foreign acquisitions are accompanied by a within-firm redistribution of knowledge, as indicated by an increase in top-bottom inequality in the component of wages due to average education, experience and tenure (all of which are worker attributes that tend to be positively associated with knowledge).

6 Effects of foreign takeovers on use of information technologies

In this section we exploit an auxiliary firm-level data set for the period 2004-2009 to examine empirically one of the potential channels of causation identified above: foreign acquisitions lead to the adoption of information technologies that are expected to improve the information flow within the organization, and thereby reduce internal communication costs.

To this end, we merged *Quadros de Pessoal* with data from *Inquérito à Utilização de Tecnologias de Informação e da Comunicação nas Empresas*, a firm-level survey conducted since 2004 by the National Statistical Institute which gathers information on the use of information technologies. Interestingly for our purposes, this survey collects information on whether the firm makes use of several information technologies that are expected to stimulate efficient communication flows in the organization, notably the intranet, the e-mail, and internal networks. The survey also contains information on whether firms use the extranet, which would be expected to predominately improve information flows between the firm and outside parties. Using unique firm identifiers provided by the National Statistical Institute, we were able to match information for 1624 firms from our main sample, of which 172 were acquired by foreign investors during the period of analysis.

Table A7 provides summary statistics on these linked auxiliary survey data. These statistics reveal that the majority of firms in this sample used the intranet, the e-mail, or internal networks: in the full sample, the proportion of firm-year observations for which these indicators take the value of one ranges between 69.9% and 99.4%. The proportion of firms using the extranet in the full sample is lower at 44%. These statistics also reveal that firms acquired by foreign investors are more likely to use all these information technologies. These proportions are higher in the matched sample than in the full sample. The share of firms using the e-mail is very close to unity in the full sample and equals one in the matched sample. Therefore, the data do not appear to exhibit sufficient variation to examine the effects of foreign acquisition on the use of

this technology.

[Table 13 here]

In order to examine whether foreign acquisitions impact the use of each of these technologies, we adopt the identification strategy outlined in Section 4. The difference-in-differences estimates in Panel A of Table 13 reveal that foreign acquisitions lead to a statistically significant and strong increase in the propensity to use the intranet. This finding holds both in the full sample (columns (1) and (2)) and in the matched sample (columns (3) and (4)).

A potential concern about this result is that treated and control firms might exhibit pre-acquisition differences in the use of the intranet. For robustness, in Table A8 we examine the effects of foreign acquisitions on the use of this technology in a sample of firms that was matched also on intranet use prior to the foreign acquisition. Reassuringly, the estimates of interest remain positive, significant and fairly large in magnitude.

It is important to emphasize that the analysis in this section is based on a smaller and less representative sample of firms.[19] This feature of the data recommends particular caution in drawing strong conclusions from these results. With this caveat in mind, it is interesting that these estimates are in line with the predictions of the theory of knowledge-based hierarchies. In particular, since the intranet is essentially aimed at promoting more efficient communication flows inside organizations, the fact that its use tends to increases following foreign acquisition can be interpreted as supporting evidence for one of the precise mechanisms emphasized by this class of models, as explained and discussed in Section 5.

7 Concluding remarks

Recent theories of knowledge-based hierarchies suggest that reorganization, through changes in hierarchical layers of employees, is key to understand how firms expand and contract and the evolution of pay in each layer. While existing evidence lends strong support to this class of models, relatively little is known about whether and how different economic or policy shocks can lead to firm reorganization and thereby influence labor market outcomes.

We exploited comprehensive data on Portuguese firms and their workers spanning the period 1991 to 2009 to study the effect of foreign takeovers on the internal organization and pay structure of firms. Our results provide evidence that foreign acquisitions lead to: (1) an expansion in the scale of operations; (2) a higher number of hierarchical layers; and (3) increased wage inequality between the top and bottom layers in firms that reorganize and add layers. These results accord well with a theory of knowledge-based hierarchies in which foreign takeovers lead

[19] Besides covering a much shorter time period, this data set includes all Portuguese firms only above a certain size (more than 250 employees). For smaller firms, the data include only a stratified random sample that is drawn each year. This implies a clear bias towards larger firms in the process of linking this data with data from our main sample, as evidenced by a considerably higher average firm size (as well as labor productivity and average wage) in the sample based on the auxiliary data (Table A7) than in the sample used in the main analysis (Table 1).

to improved productivity, higher demand, or reduced communication costs within the acquired firms. Using an auxiliary survey data set, we provided evidence that foreign acquisition has a positive and significant effect on the use of the intranet. Although the small size of this sample recommends caution in drawing strong conclusions from this result, we interpret it as suggestive that reduced communication costs played some role in driving the impacts of foreign acquisitions.

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A Appendix

A.1 Foreign direct investment in Portugal

Table A1 reports evidence on the stocks and rates of growth of foreign direct investment in Portugal during the period 1996-2009.

[Table A1 here]

A.2 Definition of hierarchical layers

Following Caliendo, Monte and Rossi-Hansberg (2015), we use detailed information on workers occupation to construct four hierarchical layers of employees. Table A2 presents the definition of these occupations.

[Table A2 here]

A.3 Definitions of variables from *Quadros de Pessoal*

Here we describe in more detail the variables used in the main analysis:

Foreign ownership: Dummy variable that equals one if more than 50% of capital is owned by foreign investors;

Sales: Total value of sales (in Portugal and abroad) of the firm during the reference year;

Employment: Number of employees at the firm in October of the reference year;

Labor productivity: Ratio between the the total value of sales and employment during the reference year;

Number of layers: Number of hierarchical layers at the firm in October of the reference year;

Hourly wage: Ratio between the wage bill and the total number of hours worked at the firm in October of the reference year. The wage bill is computed on the basis of the monthly wage and employment. The monthly wage includes the base wage and other components of pay;

Hours: Total number of hours worked at the firm-layer in the reference year.

Education: Average number of years of schooling of employees at the firm-layer in the reference year;

Tenure: Average number of years of tenure of employees at the firm-layer in the reference year;

Potential experience: Average number of years of potential labor market experience of employees at the firm-layer in the reference year. Potential experience is defined as the difference between the worker's age and the number of years of schooling;

All monetary variables are in euros and have been deflated to constant 2009 prices using GDP and CPI deflators (obtained from AMECO) for sales and wages, respectively.

A.4 Definitions of variables from *Inquérito à Utilização de Tecnologias de Informação e da Comunicação nas Empresas*

Here we describe in more detail the variables employed in the analysis using auxiliary survey data:

Use of intranet: Dummy variable that equals one if the firm has intranet in the reference year;

Use of e-mail: Dummy variable that equals one if the firms uses the e-mail in the reference year;

Use of extranet: Dummy variable that equals one if the firms uses the extranet in the reference year;

Use of internal networks: Dummy variable that equals one if the firms uses internal networks in the reference year.

A.5 Additional summary statistics

Table A3 provides summary statistics on the estimation sample relative to the private sector as a whole.

[Table A3 here]

A.6 Propensity score matching

Table A4 shows the tests of matching quality discussed in Section 4.1.

[Table A4 here]

A.7 Additional results

Table A5 reports the effects of foreign ownership on employment.

[Table A5 here]

Table A6 reports the effects of foreign ownership on sales, labor productivity, hourly wage and number of layers using the pooled sample.

[Table A6 here]

A.8 Summary statistics and robustness, auxiliary survey data

Table A7 provides summary statistics on auxiliary survey data from *Inquérito à Utilização de Tecnologias de Informação e da Comunicação nas Empresas*. Table A8 reports effects of foreign acquisition on the use of intranet using a sample of firms matched also on intranet use prior to the foreign acquisition.

[Table A7 here]
[Table A8 here]

Table 1: Summary statistics, full sample, 1991-2009

	All firms	Always domestic	Acquired by foreign investors
	(1)	(2)	(3)
Log sales	14.0677	14.0411	15.5926
	(1.3365)	(1.3169)	(1.5529)
Employment	42.1986	40.4140	144.7823
	(143.0868)	(128.6462)	(485.1442)
Log labor productivity	10.8681	10.8561	11.5595
	(1.0532)	(1.0453)	(1.2592)
Number of layers	2.0508	2.0411	2.6098
	(0.7620)	(0.7572)	(0.8227)
Log hourly wage	1.4504	1.4419	1.9366
	(0.4146)	(0.4073)	(0.5263)
Education (years of schooling)	6.2147	6.1780	8.3235
	(2.1079)	(2.0792)	(2.6149)
Tenure (years)	7.4826	7.4883	7.1516
	(5.2359)	(5.2356)	(5.2389)
Potential experience (years)	25.8508	25.9121	22.3306
	(6.5251)	(6.5114)	(6.3436)
N (obs.)	432,955	425,552	7,403
N (firms)	74,666	73,728	938

Notes: The table reports means and standard deviations (in parentheses) for the full sample of firm-year observations with at least 10 employees over the period 1991-2009 (except 2001 and 2002) of firms that are not foreign owned in their first year in the sample. A firm is foreign owned if foreign investors hold at least 50% of capital. Column (1) refers to all firms, column (2) refers to firms that did not change ownership during the sample period, and column (3) refers to firms that changed foreign ownership status only once during the sample period. Monetary variables are in 2009 prices.

Table 2: The acquisition decision

	Dependent variable: foreign ownership							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log sales	0.7195***	0.7199***						
	(0.0226)	(0.0226)						
	[0.0036***]	[0.0035***]						
2nd quartile			0.6341***	0.6343***				
			(0.1319)	(0.1317)				
			[0.0031***]	[0.0030***]				
3rd quartile			1.4868***	1.4849***				
			(0.1259)	(0.1256)				
			[0.0074***]	[0.0070***]				
4th quartile			2.8248***	2.8298***				
			(0.1147)	(0.1148)				
			[0.0140***]	[0.0133***]				
Log labor productivity					0.6759***	0.6758***		
					(0.0377)	(0.0379)		
					[0.0046***]	[0.0044***]		
2nd quartile							0.1241	0.1114
							(0.1033)	(0.1035)
							[0.0008]	[0.0007]
3rd quartile							0.7007***	0.6894***
							(0.1063)	(0.1066)
							[0.0046***]	[0.0043***]
4th quartile							1.6708***	1.6663***
							(0.1010)	(0.1015)
							[0.0111***]	[0.0105***]
Industry trends	N	Y	N	Y	N	Y	N	Y
N (obs.)	432,955	432,955	432,955	432,955	432,955	432,955	432,955	432,955
N (firms)	74,666	74,666	74,666	74,666	74,666	74,666	74,666	74,666

Notes: Standard errors in parentheses clustered at firm level. *10% level, **5% level, and ***1% level. Log sales and log labor productivity are relative to the industry mean and lagged one year relative to the dependent variable. All regressions include year and industry dummies. Marginal effects at the mean of the variables in square brackets.

Table 3: Propensity score estimates

Dependent variable: foreign ownership		
	Coefficient	Marginal effect (at mean of variable)
	(1)	(2)
Log sales	0.4477***	0.00026***
	(0.0453)	(0.00003)
Sales growth	0.0017*	0.00000*
	(0.0009)	(0.00000)
Log labor productivity	-0.4274***	-0.00025***
	(0.0675)	(0.00004)
Labor productivity growth	-0.0020	-0.00000
	(0.0014)	(0.00000)
Log hourly wage	4.2675***	0.00250***
	(0.3992)	(0.00021)
Log hourly wage squared	-0.5318***	-0.00031***
	(0.0873)	(0.00005)
Hourly wage growth	0.1302***	0.00008***
	(0.0132)	(0.00004)
Number of layers	0.0644	0.00004
	(0.0643)	(0.00004)
Industry effects	Yes	
Year effects	Yes	
N (obs.)	424,533	
N (firms)	74,269	

Notes: All independent variables defined in levels are lagged one year (prior to acquisition). Growth of sales, labor productivity and hourly wages is calculated between the year prior to acquisition and the acquisition year. Standard errors in parentheses clustered at the firm-level. *10% level, **5% level, and ***1% level.

Table 4: Summary statistics, matched sample, year prior to acquisition

	Always domestic	Acquired by foreign investors	Difference in means, t-test	p-value
	(1)	(2)	(3)	(4)
Log sales	15.078	15.060	-0.20	0.845
Sales growth	4.917	4.216	-0.20	0.842
Lagged sales growth*	3.888	13.778	1.45	0.148
Log labor productivity	11.263	11.307	0.59	0.558
Labor productivity growth	3.945	3.720	-0.08	0.938
Lagged labor productivity growth*	3.483	14.682	1.56	0.118
Log hourly wage	1.847	1.869	0.76	0.447
Hourly wage growth	0.052	0.081	0.88	0.381
Lagged hourly wage growth*	0.187	0.084	-2.30	0.022
Employment	112.6	92.4	-1.01	0.311
Number of layers	2.432	2.432	0.00	1.000
N (obs.)	616	616		
N (firms)	598	616		

Notes: The table reports means for the matched sample of firm-year observations with at least 10 employees in the year prior to acquisition. A firm is foreign owned if foreign investors hold at least 50% of capital. Column (1) refers to firms that did not change ownership during the sample period, and column (2) refers to firms that changed foreign ownership status only once during the sample period. Growth of sales, labor productivity and hourly wages is calculated between the year prior to acquisition and the year of acquisition. Lagged growth of these variables is calculated between two years prior to acquisition and one year prior to the acquisition. For variables marked with an asterisk, the sample refers to 400 (329) domestic (acquired) firms due to missing data.

Table 5: Summary statistics, matched sample, 1991-2009

	All firms	Always domestic	Acquired by foreign investors
	(1)	(2)	(3)
Log sales	15.4336	15.2731	15.6303
	(1.6001)	(1.6236)	(1.5485)
Employment	141.7982	138.2111	146.1925
	(525.3862)	(576.9171)	(454.3826)
Log labor productivity	11.4536	11.3555	11.5737
	(1.1940)	(1.1294)	(1.2583)
Number of layers	2.5552	2.5149	2.6047
	(0.8188)	(0.8147)	(0.8212)
Log hourly wage	1.8390	1.7769	1.9150
	(0.4913)	(0.4603)	(0.5167)
Education (years of schooling)	7.6174	7.1569	8.1817
	(2.4798)	(2.3794)	(2.4839)
Tenure (years)	8.5725	9.6840	7.2108
	(5.5509)	(5.5832)	(5.1971)
Potential experience (years)	24.4632	26.0816	22.4806
	(6.4633)	(6.2607)	(6.1481)
N (obs.)	11,082	5,985	5,097
N (firms)	1214	598	616

Notes: The table reports means and standard deviations (in parentheses) for the matched sample of firm-year observations with more than 10 employees over the period 1991-2009 (except 2001 and 2002) of firms that are not foreign owned in their first year in the sample. A firm is foreign owned if foreign investors hold at least 50% of capital. Column (1) refers to all firms, column (2) refers to firms that did not change ownership during the sample period, and column (3) refers to firms that changed foreign ownership status only once during the sample period. Monetary variables are in 2009 prices.

Table 6: Effects of foreign acquisition on sales, labor productivity and hourly wage

Dependent variable:	log sales		log labor productivity		log hourly wage	
	(1)	(2)	(3)	(4)	(5)	(6)
Firms with initially 1 layer						
Foreign ownership	0.1443	0.1372	0.0653	0.0359	0.0423	0.0281
	(0.1253)	(0.1230)	(0.1186)	(0.1142)	(0.0308)	(0.0315)
Industry trends	N	Y	N	Y	N	Y
N (obs.)	1,446	1,446	1,446	1,446	1,446	1,446
N (firms)	181	181	181	181	181	181
Firms with initially 2 layers						
Foreign ownership	0.3226***	0.3288***	0.1607**	0.1660**	0.0488**	0.0476**
	(0.0914)	(0.0895)	(0.0703)	(0.0705)	(0.0226)	(0.0226)
Industry trends	N	Y	N	Y	N	Y
N (obs.)	3,763	3,763	3,763	3,763	3,763	3,763
N (firms)	432	432	432	432	432	432
Firms with initially 3 layers						
Foreign ownership	0.2955***	0.3003***	0.1611**	0.1677**	0.0737***	0.0726***
	(0.0858)	(0.0872)	(0.0769)	(0.0787)	(0.0201)	(0.0202)
Industry trends	N	Y	N	Y	N	Y
N (obs.)	4,938	4,938	4,938	4,938	4,938	4,938
N (firms)	510	510	510	510	510	510
Firms with initially 4 layers						
Foreign ownership	0.2511	0.272	0.1568	0.1817	0.1398***	0.1331***
	(0.1738)	(0.1761)	(0.1426)	(0.1461)	(0.0507)	(0.0484)
Industry trends	N	Y	N	Y	N	Y
N (obs.)	976	976	976	976	976	976
N (firms)	94	94	94	94	94	94

Notes: Foreign ownership status is lagged one year. All regressions include year dummies. Standard errors in parentheses clustered at firm level. *10% level, **5% level, and ***1% level.

Table 7: Effects of foreign acquisition on the number of layers

Dependent variable:	number of layers	
	(1)	(2)
Firms with initially 1 layer		
Foreign ownership	0.2123***	0.1975**
	(0.0819)	(0.0811)
Industry trends	N	Y
N (obs.)	1,446	1,446
N (firms)	181	181
Firms with initially 2 layers		
Foreign ownership	0.2119***	0.2063***
	(0.0590)	(0.0578)
Industry trends	N	Y
N (obs.)	3,763	3,763
N (firms)	432	432
Firms with initially 3 layers		
Foreign ownership	0.0698*	0.0676*
	(0.0403)	(0.0399)
Industry trends	N	Y
N (obs.)	4,938	4,938
N (firms)	510	510
Firms with initially 4 layers		
Foreign ownership	0.0244	-0.0245
	(0.1238)	(0.1240)
Industry trends	N	Y
N (obs.)	976	976
N (firms)	94	94

Notes: Foreign ownership status is lagged one year. All regressions include year dummies. Standard errors in parentheses clustered at firm level. *10% level, **5% level, and ***1% level.

Table 8: Effects of foreign acquisition on log hourly layer-level wages for firms that did not change the organization

Dependent variable:	log hourly wage		Observed		Residual	
	(1)	(2)	(3)	(4)	(5)	(6)
Firms with 1 layer						
Dependent variable: log hourly wage of layer 0						
Foreign ownership	-0.0079	-0.0179	0.017	0.0059	-0.0248	-0.0238
	(0.0449)	(0.0492)	(0.0266)	(0.0279)	(0.0489)	(0.0540)
Industry trends	N	Y	N	Y	N	Y
N (obs.)	767	767	767	767	767	767
N (firms)	163	163	163	163	163	163
Firms with 2 layers						
Dependent variable: log hourly wage of layer 0						
Foreign ownership	0.0016	0.0018	-0.0039	-0.0021	0.0055	0.0039
	(0.0353)	(0.0352)	(0.0155)	(0.0153)	(0.0321)	(0.0317)
Industry trends	N	Y	N	Y	N	Y
N (obs.)	2,088	2,088	2,088	2,088	2,088	2,088
N (firms)	413	413	413	413	413	413
Dependent variable: log hourly wage of layer 1						
Foreign ownership	0.0291	0.0273	0.0299	0.0294	-0.0009	-0.0021
	(0.0447)	(0.0452)	(0.0202)	(0.0201)	(0.0442)	(0.0437)
Industry trends	N	Y	N	Y	N	Y
N (obs.)	1,772	1,772	1,772	1,772	1,772	1,772
N (firms)	380	380	380	380	380	380
Firms with 3 layers						
Dependent variable: log hourly wage of layer 0						
Foreign ownership	0.0273	0.0287	-0.0124	-0.0115	0.0397*	0.0402*
	(0.0231)	(0.0238)	(0.0087)	(0.0084)	(0.0222)	(0.0229)
Industry trends	N	Y	N	Y	N	Y
N (obs.)	3,309	3,309	3,309	3,309	3,309	3,309
N (firms)	493	493	493	493	493	493
Dependent variable: log hourly wage of layer 1						
Foreign ownership	0.0233	0.0214	-0.0001	-0.0004	0.0234	0.0218
	(0.0306)	(0.0314)	(0.0144)	(0.0142)	(0.0284)	(0.0294)
Industry trends	N	Y	N	Y	N	Y
N (obs.)	3,292	3,292	3,292	3,292	3,292	3,292
N (firms)	493	493	493	493	493	493

Notes: Foreign ownership status is lagged one year. All regressions include year dummies. Standard errors in parentheses clustered at firm level. *10% level, **5% level, and ***1% level.

Table 8: Effects of foreign acquisition on log hourly layer-level wages for firms that did not change the organization (cont.)

Dependent variable:	log hourly wage		Observed		Residual	
	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable: log hourly wage of layer 2						
Foreign ownership	0.0928**	0.1035**	0.0132	0.0179	0.0796*	0.0856*
	(0.0428)	(0.0422)	(0.0188)	(0.0189)	(0.0417)	(0.0412)
Industry trends	N	Y	N	Y	N	Y
N (obs.)	2,839	2,839	2,839	2,839	2,839	2,839
N (firms)	462	462	462	462	462	462
Firms with 4 layers						
Dependent variable: log hourly wage of layer 0						
Foreign ownership	0.1388*	0.1660**	-0.0064	-0.0006	0.1452*	0.1666*
	(0.0735)	(0.0805)	(0.0219)	(0.0190)	(0.0781)	(0.0850)
Industry trends	N	Y	N	Y	N	Y
N (obs.)	402	402	402	402	402	402
N (firms)	87	87	87	87	87	87
Dependent variable: log hourly wage of layer 1						
Foreign ownership	0.2159***	0.2099***	0.0185	0.0096	0.1974***	0.2003***
	(0.0728)	(0.0633)	(0.0362)	(0.0359)	(0.0671)	(0.0634)
Industry trends	N	Y	N	Y	N	Y
N (obs.)	402	402	402	402	402	402
N (firms)	87	87	87	87	87	87
Dependent variable: log hourly wage of layer 2						
Foreign ownership	0.1406	0.1664*	0.0229*	0.0230*	0.1177	0.1434
	(0.0998)	(0.1000)	(0.0119)	(0.0131)	(0.0998)	(0.0998)
Industry trends	N	Y	N	Y	N	Y
N (obs.)	392	392	392	392	392	392
N (firms)	85	85	85	85	85	85
Dependent variable: log hourly wage of layer 3						
Foreign ownership	0.1454	0.1912	0.0038	-0.0081	0.1417	0.1993
	(0.2612)	(0.2759)	(0.0802)	(0.0918)	(0.2375)	(0.2497)
Industry trends	N	Y	N	Y	N	Y
N (obs.)	363	363	363	363	363	363
N (firms)	81	81	81	81	81	81

Notes: Foreign ownership status is lagged one year. All regressions include year dummies. Standard errors in parentheses clustered at firm level. *10% level, **5% level, and ***1% level.

Table 9: Effects of foreign acquisition on log hourly wages for firms that increase the number of layers

Dependent variable:	log hourly wage		Observed		Residual	
	(1)	(2)	(3)	(4)	(5)	(6)
Firms with initially 1 layer						
Dependent variable: log hourly wage of layer 0						
Foreign ownership	0.0840**	0.0601	-0.0123	-0.0089	0.0962**	0.0691
	(0.0415)	(0.0409)	(0.0218)	(0.0216)	(0.0445)	(0.0444)
Industry trends	N	Y	N	Y	N	Y
N (obs.)	824	824	824	824	824	824
N (firms)	160	160	160	160	160	160
Firms with initially 2 layers						
Dependent variable: log hourly wage of layer 0						
Foreign ownership	0.0098	0.0021	-0.0174	-0.0177	0.0272	0.0198
	(0.0361)	(0.0360)	(0.0218)	(0.0216)	(0.0455)	(0.0465)
Industry trends	N	Y	N	Y	N	Y
N (obs.)	1,846	1,846	1,846	1,846	1,846	1,846
N (firms)	372	372	372	372	372	372
Dependent variable: log hourly wage of layer 1						
Foreign ownership	-0.0903	-0.1011	-0.0109	-0.0121	-0.0794	-0.0890
	(0.0649)	(0.0670)	(0.0180)	(0.0178)	(0.0661)	(0.0687)
Industry trends	N	Y	N	Y	N	Y
N (obs.)	1,678	1,678	1,678	1,678	1,678	1,678
N (firms)	345	345	345	345	345	345
Firms with initially 3 layers						
Dependent variable: log hourly wage of layer 0						
Foreign ownership	0.0425*	0.0368	-0.0073	-0.0067	0.0498**	0.0436**
	(0.0235)	(0.0239)	(0.0079)	(0.0078)	(0.0215)	(0.0220)
Industry trends	N	Y	N	Y	N	Y
N (obs.)	2,768	2,768	2,768	2,768	2,768	2,768
N (firms)	490	490	490	490	490	490
Dependent variable: log hourly wage of layer 1						
Foreign ownership	-0.0032	-0.0055	-0.0075	-0.0071	0.0043	0.0016
	(0.0306)	(0.0319)	(0.0069)	(0.0068)	(0.0305)	(0.0316)
Industry trends	N	Y	N	Y	N	Y
N (obs.)	2,701	2,701	2,701	2,701	2,701	2,701
N (firms)	489	489	489	489	489	489
Dependent variable: log hourly wage of layer 2						
Foreign ownership	0.0678	0.0639	-0.0110	-0.0082	0.0788*	0.0721
	(0.0465)	(0.0465)	(0.0087)	(0.0087)	(0.0478)	(0.0477)
Industry trends	N	Y	N	Y	N	Y
N (obs.)	2,121	2,121	2,121	2,121	2,121	2,121
N (firms)	433	433	433	433	433	433

Notes: Foreign ownership status is lagged one year. All regressions include year dummies. Standard errors in parentheses clustered at firm level. *10% level, **5% level, and ***1% level.

Table 10: Effects of foreign acquisition on log hourly wage of top and bottom layers

Dependent variable:	log hourly wage		Observed		Residual	
	(1)	(2)	(3)	(4)	(5)	(6)
Firms with initially 1 layer						
Dependent variable: log hourly wage of top layer						
Foreign ownership	0.1258	0.1070	0.1452**	0.1628**	-0.0193	-0.0257
	(0.0788)	(0.0810)	(0.0602)	(0.0582)	(0.0679)	(0.0734)
Industry trends	N	Y	N	Y	N	Y
N (obs.)	1,232	1,232	1,232	1,232	1,232	1,232
N (firms)	180	180	180	180	180	180
Dependent variable: log hourly wage of layer 0						
Foreign ownership	0.0246	0.0150	0.0118	0.0077	0.0128	0.0073
	(0.0309)	(0.0317)	(0.0199)	(0.0204)	(0.0349)	(0.0361)
Industry trends	N	Y	N	Y	N	Y
N (obs.)	1,446	1,446	1,446	1,446	1,446	1,446
N (firms)	181	181	181	181	181	181
Firms with initially 2 layers						
Dependent variable: log hourly wage of top layer						
Foreign ownership	0.1540***	0.1552***	0.0684*	0.0740**	0.0857**	0.0712**
	(0.0512)	(0.0517)	(0.0377)	(0.0373)	(0.0415)	(0.0409)
Industry trends	N	Y	N	Y	N	Y
N (obs.)	3,089	3,089	3,089	3,089	3,089	3,089
N (firms)	418	418	418	418	418	418
Dependent variable: log hourly wage of layer 0						
Foreign ownership	-0.0006	-0.0018	-0.0101	-0.0076	0.0095	0.0058
	(0.0227)	(0.0227)	(0.0123)	(0.0122)	(0.0236)	(0.0235)
Industry trends	N	Y	N	Y	N	Y
N (obs.)	3,763	3,763	3,763	3,763	3,763	3,763
N (firms)	432	432	432	432	432	432

Table 10: Effects of foreign acquisition on log hourly wage of top and bottom layers (cont.)

Dependent variable:	log hourly wage		Observed		Residual	
	(1)	(2)	(3)	(4)	(5)	(6)
Firms with initially 3 layers						
Dependent variable: log hourly wage of top layer						
Foreign ownership	0.1075**	0.1117**	0.0311	0.0331	0.0765*	0.0786*
	(0.0453)	(0.0451)	(0.0266)	(0.0268)	(0.0408)	(0.0408)
Industry trends	N	Y	N	Y	N	Y
N (obs.)	4,285	4,285	4,285	4,285	4,285	4,285
N (firms)	498	498	498	498	498	498
Dependent variable: log hourly wage of layer 0						
Foreign ownership	0.0246	0.0214	-0.0077	-0.0081	0.0323*	0.0294
	(0.0193)	(0.0197)	(0.0078)	(0.0077)	(0.0190)	(0.0193)
Industry trends	N	Y	N	Y	N	Y
N (obs.)	4,938	4,938	4,938	4,938	4,938	4,938
N (firms)	510	510	510	510	510	510
Firms with initially 4 layers						
Dependent variable: log hourly wage of top layer						
Foreign ownership	0.0119	-0.0118	-0.1058	-0.1184	0.1178	0.1066
	(0.1379)	(0.1389)	(0.0843)	(0.0846)	(0.1214)	(0.119)
Industry trends	N	Y	N	Y	N	Y
N (obs.)	874	874	874	874	874	874
N (firms)	94	94	94	94	94	94
Dependent variable: log hourly wage of layer 0						
Foreign ownership	0.1556***	0.1617***	0.0071	0.0105	0.1485***	0.1511***
	(0.0498)	(0.0502)	(0.0193)	(0.0182)	(0.0487)	(0.0495)
Industry trends	N	Y	N	Y	N	Y
N (obs.)	976	976	976	976	976	976
N (firms)	94	94	94	94	94	94

Notes: Foreign ownership status is lagged one year. All regressions include year dummies. Standard errors in parentheses clustered at firm level. *10% level, **5% level, and ***1% level.

Table 11: Effects of foreign acquisition on top-bottom internal wage inequality

Dependent variable:	Wage difference between top and bottom layers		Observed		Residual	
	(1)	(2)	(3)	(4)	(5)	(6)
Firms with initially 1 layer						
Foreign ownership	0.1115	0.1040	0.1097**	0.1056**	0.0018	-0.0016
	(0.0751)	(0.0772)	(0.0529)	(0.0517)	(0.0527)	(0.0568)
Industry trends	N	Y	N	Y	N	Y
N (obs.)	1,232	1,232	1,232	1,232	1,232	1,232
N (firms)	180	180	180	180	180	180
Firms with initially 2 layers						
Foreign ownership	0.1568***	0.1581***	0.0637*	0.0656*	0.0931**	0.0926**
	(0.0546)	(0.0553)	(0.0346)	(0.0346)	(0.0426)	(0.0428)
Industry trends	N	Y	N	Y	N	Y
N (obs.)	3,089	3,089	3,089	3,089	3,089	3,089
N (firms)	418	418	418	418	418	418
Firms with initially 3 layers						
Foreign ownership	0.0805*	0.0864*	0.0366	0.0383*	0.0439	0.0480
	(0.0487)	(0.0487)	(0.0228)	(0.0233)	(0.0436)	(0.0438)
Industry trends	N	Y	N	Y	N	Y
N (obs.)	4,285	4,285	4,285	4,285	4,285	4,285
N (firms)	498	498	498	498	498	498
Firms with initially 4 layers						
Foreign ownership	-0.1372	-0.1709	-0.0637	-0.0783	-0.0735	-0.0926
	(0.1438)	(0.1439)	(0.0692)	(0.0691)	(0.1273)	(0.1253)
Industry trends	N	Y	N	Y	N	Y
N (obs.)	874	874	874	874	874	874
N (firms)	94	94	94	94	94	94

Notes: Foreign ownership status is lagged one year. All regressions include year dummies. Standard errors in parentheses clustered at firm level. *10% level, **5% level, and ***1% level.

Table 12: Effects of foreign acquisition on normalized hours

Sample	Firms that keep the number of layers		Firms that increase the number of layers		All firms	
	(1)	(2)	(3)	(4)	(5)	(6)
Firms with initially 1 layer						
Dependent variable: normalized hours of layer 0						
Foreign ownership			13.9309**	14.2290*	9.7701**	10.3958*
			(6.9775)	(7.7709)	(4.9335)	(5.5063)
Industry trends			N	Y	N	Y
N (obs.)			665	665	1,232	1,232
N (firms)			159	159	180	180
Firms with initially 2 layers						
Dependent variable: normalized hours of layer 0						
Foreign ownership	1.5527	1.2954	11.9954	11.0701	0.3557	0.7795
	(2.0931)	(1.9229)	(12.2355)	(12.1946)	(4.6795)	(4.5601)
Industry trends	N	Y	N	Y	N	Y
N (obs.)	1,772	1,772	1,440	1,440	3,089	3,089
N (firms)	380	380	332	332	418	418
Firms with initially 3 layers						
Dependent variable: normalized hours of layer 0						
Foreign ownership	17.434	16.263	-2.7641	-4.8517	4.5824	2.8143
	(12.7673)	(12.9900)	(15.8110)	(16.2259)	(12.6778)	(13.0055)
Industry trends	N	Y	N	Y	N	Y
N (obs.)	2,839	2,839	2,450	2,450	4,285	4,285
N (firms)	462	462	467	467	498	498
Dependent variable: normalized hours of layer 1						
Foreign ownership	2.2711	2.2359	0.1784	0.0652		
	(1.6022)	(1.6454)	(3.2434)	(3.2720)		
Industry trends	N	Y	N	Y		
N (obs.)	2,839	2,839	2,072	2,072		
N (firms)	462	462	432	432		

Table 12: Effects of foreign acquisition on normalized hours (cont.)

Sample	Firms that keep the number of layers		Firms that increase the number of layers		Bottom layer of all firms	
	(1)	(2)	(3)	(4)	(5)	(6)
Firms with initially 4 layers						
Dependent variable: normalized hours of layer 0						
Foreign ownership	2.4573	7.5276			-10.3235	-9.7779
	(11.9307)	(9.7302)			(14.4428)	(14.8628)
Industry trends	N	Y			N	Y
N (obs.)	363	363			874	874
N (firms)	81	81			94	94
Dependent variable: normalized hours of layer 1						
Foreign ownership	4.1718	5.1704				
	(4.0971)	(3.5562)				
Industry trends	N	Y				
N (obs.)	363	363				
N (firms)	81	81				
Dependent variable: normalized hours of layer 2						
Foreign ownership	0.2297	0.3651				
	(0.9298)	(0.9510)				
Industry trends	N	Y				
N (obs.)	363	363				
N (firms)	81	81				

Notes: Foreign ownership status is lagged one year. All regressions include year dummies. Standard errors in parentheses clustered at firm level. *10% level, **5% level, and ***1% level.

Table 13: Effects of foreign acquisition on the use of information technologies

	Full sample		Matched sample	
	(1)	(2)	(3)	(4)
A. Dependent variable: use of intranet				
Foreign ownership	0.1989***	0.2041***	0.2238**	0.2838***
	(0.0617)	(0.0622)	(0.0973)	(0.104)
Industry trends	N	Y	N	Y
N (obs.)	4,268	4,268	200	200
N (firms)	1,624	1,624	61	61
B. Dependent variable: use of email				
Foreign ownership	-0.0017	-0.0012	n.d.	n.d.
	(0.0012)	(0.0011)	n.d.	n.d.
Industry trends	N	Y		
Matched sample	N	N		
N (obs.)	4,268	4,268		
N (firms)	1,624	1,624		
C. Dependent variable: use of extranet				
Foreign ownership	0.0218	0.0156	0.1017	0.0781
	(0.1054)	(0.1053)	(0.1367)	(0.1518)
Industry trends	N	Y	N	Y
N (obs.)	4,268	4,268	200	200
N (firms)	1,624	1,624	61	61
D. Dependent variable: use of internal networks				
Foreign ownership	-0.0292***	-0.0291***	-0.0162	-0.0106
	(0.0097)	(0.0100)	(0.0203)	(0.0139)
Industry trends	N	Y	N	Y
N (obs.)	4,268	4,268	200	200
N (firms)	1,624	1,624	61	61

Notes: Foreign ownership status is lagged one year. All regressions include year dummies. Standard errors in parentheses clustered at firm level. *10% level, **5% level, and *1% level.

Table A1: Foreign direct investment in Portugal, 1996-2009

	1996		2009		annual growth rate 1996-2009
	stock	% of total	stock	% of total	
	(1)	(2)	(3)	(4)	(5)
Spain	7,848	28.57	22,597	24.04	8.5
France	3,532	12.86	6,118	6.51	4.3
United Kingdom	2,835	10.32	6,973	7.42	7.2
Netherlands	2,664	9.70	16,747	17.81	15.2
Germany	2,423	8.82	3,035	3.23	1.7
USA	1,597	5.81	1,442	1.53	-0.8
Switzerland	1,237	4.50	850	0.90	-2.9
Luxembourg	1,148	4.18	7,393	7.86	15.4
Italy	587	2.14	4,280	4.55	16.5
Belgium	469	1.71	1,075	1.14	6.6
Brazil	436	1.59	3,703	3.94	17.9
Ireland	134	0.49	1,422	1.51	19.9
Angola	7	0.03	255	0.27	31.8
European Union	22,815	83.04	72,043	76.64	9.2
Total	27,473	100.00	94,005	100.00	9.9

Notes: The table reports end-of-year stocks of foreign direct investment in Portugal by country of origin in 1996 and 2009. Stocks are in millions of euros at 2009 prices. Column (5) reports the annual average rate of growth of FDI stocks between 1996 and 2009. Data come from the Balance of Payments Statistics of the Central Bank of Portugal. Data are reported in accordance with BPM6 methodology and were updated in February 2016. Data prior to 1996 are not available.

Table A2: Definition of hierarchical occupations

Occupation level	Occupations	Correspondence in CNP94
CEO and Directors	"General directors" and "directors and managers of small firms"	121; 131
Top managers	"Directors of production, finance or other"	122, 123
Supervisors	"Specialists in scientific and intellectual jobs"; "Intermediate-level technicians and professionals"	between 200 and 400
Operators	"Administrative staff"; "Service and sales staff"; "Workers and craft"; "Machine operators";"Unskilled workers"	above 400

Notes: The table reports the definition of occupations included in each layer using the 1994 National Classification of Occupations (CNP94)

Table A3: Importance of the estimation sample in the private sector as a whole

Year	All firms			Always domestic			Acquired by foreign investors		
	Sales	Empl.	Wage bill	Sales	Empl.	Wage bill	Sales	Empl.	Wage bill
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1992	0.5548	0.5673	0.5883	0.5276	0.5361	0.5546	0.0270	0.0270	0.0283
1993	0.5806	0.5907	0.6090	0.5278	0.5551	0.5712	0.0339	0.0281	0.0292
1994	0.5815	0.6049	0.6240	0.5311	0.5632	0.5792	0.0492	0.0312	0.0336
1995	0.5839	0.6104	0.6283	0.5323	0.5744	0.5892	0.0496	0.0324	0.0348
1996	0.5927	0.6174	0.6340	0.5355	0.5760	0.5910	0.0509	0.0329	0.0348
1997	0.5970	0.6182	0.6351	0.5392	0.5773	0.5916	0.0535	0.0332	0.0356
1998	0.5988	0.6202	0.6369	0.5393	0.5779	0.5917	0.0540	0.0344	0.0368
1999	0.5988	0.6205	0.6408	0.5394	0.5796	0.5968	0.0542	0.0349	0.0375
2000	0.6012	0.6266	0.6437	0.5471	0.5849	0.6000	0.0548	0.0353	0.0378
2003	0.6026	0.6275	0.6456	0.5478	0.5950	0.6108	0.0550	0.0356	0.0381
2004	0.6144	0.6342	0.6525	0.5594	0.6009	0.6177	0.0563	0.0409	0.0430
2005	0.6156	0.6409	0.6538	0.5632	0.6060	0.6182	0.0565	0.0410	0.0437
2006	0.6197	0.6438	0.6620	0.5647	0.6108	0.6244	0.0578	0.0416	0.0440
2007	0.6254	0.6489	0.6727	0.5712	0.6135	0.6347	0.0594	0.0417	0.0449
2008	0.6336	0.6938	0.6995	0.5758	0.6656	0.6702	0.0595	0.0423	0.0452
2009	0.6402	0.6982	0.7041	0.6063	0.6712	0.6758	0.0615	0.0429	0.0458
N (obs.)		432,955			425,552			7,403	
N (firms)		74,666			73,728			938	

Notes: The table reports the share of sales, employment and wage bill of firms used in the estimation sample relative to the whole private sector. It includes firm-year observations with more than 10 employees of firms that are not foreign owned in their first year in the sample. A firm is foreign owned if foreign investors hold at least 50% of capital. 'Always domestic' refers to firms that did not change ownership during the sample period, 'Acquired by foreign investors' refers to firms that changed foreign ownership status only once during the sample period. Firms acquired in 2002 are excluded from the estimation sample, due to missing data for the variables included in the selection equation (values of sales, wage bill and labor productivity in 2001).

Table A4: Indicators of covariate balancing before and after matching

Panel A: t-test before and after matching

Variable	Sample	Mean		% bias	% reduction bias	t-test	p-value
		Treated	Control				
Log sales	Unmatched	15.1110	13.9820	71.8		20.680	0.000
	Matched	15.0620	15.0780	-1.3	98	-0.200	0.845
Sales growth	Unmatched	4.1640	2.1567	2.8		0.600	0.549
	Matched	4.2159	4.9165	-1.0	65	-0.200	0.842
Lagged sales growth	Unmatched	13.5760	2.2223	11.7		2.840	0.005
	Matched	13.7780	3.8880	10.2	13	1.450	0.148
Log labor productivity	Unmatched	11.3220	10.7980	41.2		11.930	0.000
	Matched	11.3070	11.2630	3.5	92	0.590	0.558
Labor productivity growth	Unmatched	3.6741	2.2034	1.8		0.350	0.728
	Matched	3.7200	3.9449	-0.3	85	-0.080	0.938
Lagged labor productivity growth	Unmatched	14.4660	2.1987	11.9		3.170	0.002
	Matched	14.6820	3.4830	10.8	9	1.560	0.118
Log hourly wage	Unmatched	1.8798	1.4127	96.6		28.420	0.000
	Matched	1.8688	1.8452	4.6	95	0.760	0.447
Log hourly wage squared	Unmatched	3.8326	2.1639	89.0		30.640	0.000
	Matched	3.7772	3.6529	6.6	93	1.050	0.292
Hourly wage growth	Unmatched	0.1452	0.0655	6.5		4.430	0.000
	Matched	0.0811	0.0516	2.4	63	0.880	0.381
Lagged hourly wage growth	Unmatched	0.1062	0.0619	9.8		2.040	0.042
	Matched	0.0839	0.1867	-22.7	-132	-2.300	0.022
Employment	Unmatched	118.89	40.24	23.4		16.090	0.000
	Matched	92.39	112.60	-6.0	74	-1.010	0.311
Number of layers	Unmatched	2.4407	2.0089	53.9		14.160	0.000
	Matched	2.4318	2.4318	0.0	100	0.000	1.000
Food, beverage, tobacco	Unmatched	0.0337	0.0475	-7.0		-1.620	0.105
	Matched	0.0308	0.0308	0.0	100	0.000	1.000
Textiles, leather	Unmatched	0.0801	0.1250	-14.8		-3.380	0.001
	Matched	0.0796	0.0796	0.0	100	0.000	1.000
Wood, cork, paper	Unmatched	0.0337	0.0487	-7.6		-1.750	0.080
	Matched	0.0341	0.0341	0.0	100	0.000	1.000
Non-metallic manufacturing	Unmatched	0.1010	0.0490	19.8		6.010	0.000
	Matched	0.1023	0.1023	0.0	100	0.000	1.000
Metallic manufacturing	Unmatched	0.1234	0.0834	13.100		3.610	0.000
	Matched	0.1250	0.1250	0.000	100	0.000	1.000
Furniture	Unmatched	0.0112	0.0280	-12.100		-2.540	0.011
	Matched	0.0114	0.0114	0.000	100	0.000	1.000
Construction	Unmatched	0.0513	0.1285	-27.200		-5.760	0.000
	Matched	0.0520	0.0520	0.000	100	0.000	1.000
Wholesale and retail trade	Unmatched	0.3093	0.2403	15.500		4.030	0.000
	Matched	0.3117	0.3117	0.000	100	0.000	1.000
Hotels and restaurants	Unmatched	0.0305	0.0733	-19.400		-4.100	0.000
	Matched	0.0308	0.0308	0.000	100	0.000	1.000
Transport, storage, other	Unmatched	0.0609	0.0354	11.900		3.430	0.001
	Matched	0.0617	0.0617	0.000	100	0.000	1.000

Table A4: Indicators of the covariate balancing before and after matching (cont.)

Panel A: t-test before and after matching (cont.)

		Mean					
	Sample	Treated	Control	% bias	% reduction bias	t-test	p-value
Post, telecommunications	Unmatched	0.0048	0.0007	8.000		4.030	0.000
	Matched	0.0016	0.0016	0.000	100	0.000	1.000
Financial intermediation	Unmatched	0.0160	0.0066	8.900		2.890	0.004
	Matched	0.0146	0.0146	0.000	100	0.000	1.000
Real estate, renting, business	Unmatched	0.1154	0.0763	13.300		3.680	0.000
	Matched	0.1153	0.1153	0.000	100	0.000	1.000
Education	Unmatched	0.0032	0.0153	-12.600		-2.460	0.014
	Matched	0.0033	0.0033	0.000	100	0.000	1.000
Health, social work	Unmatched	0.0064	0.0213	-12.700		-2.570	0.010
	Matched	0.0065	0.0065	0.000	100	0.000	1.000
Other social activities	Unmatched	0.0096	0.0128	-3.000		-0.700	0.486
	Matched	0.0097	0.0097	0.000	100	0.000	1.000
1991	Unmatched	0.1010	0.0498	19.500		5.860	0.000
	Matched	0.1023	0.1023	0.000	100	0.000	1.000
1992	Unmatched	0.0737	0.0506	9.600		2.630	0.009
	Matched	0.0747	0.0747	0.000	100	0.000	1.000
1993	Unmatched	0.0417	0.0478	-2.900		-0.710	0.477
	Matched	0.0422	0.0422	0.000	100	0.000	1.000
1994	Unmatched	0.0449	0.0509	-2.800		-0.680	0.494
	Matched	0.0455	0.0455	0.000	100	0.000	1.000
1996	Unmatched	0.0224	0.0502	-14.900		-3.170	0.002
	Matched	0.0211	0.0211	0.000	100	0.000	1.000
1997	Unmatched	0.0465	0.0516	-2.400		-0.580	0.562
	Matched	0.0471	0.0471	0.000	100	0.000	1.000
1998	Unmatched	0.0192	0.0533	-18.300		-3.790	0.000
	Matched	0.0195	0.0195	0.000	100	0.000	1.000
1999	Unmatched	0.0369	0.0559	-9.100		-2.070	0.038
	Matched	0.0373	0.0373	0.000	100	0.000	1.000
2000	Unmatched	0.0385	0.0619	-10.800		-2.430	0.015
	Matched	0.0390	0.0390	0.000	100	0.000	1.000
2002	Unmatched	0.1827	0.0694	34.600		11.120	0.000
	Matched	0.1818	0.1818	0.000	100	0.000	1.000
2003	Unmatched	0.0833	0.0713	4.500		1.170	0.242
	Matched	0.0844	0.0844	0.000	100	0.000	1.000
2004	Unmatched	0.0353	0.0748	-17.400		-3.750	0.000
	Matched	0.0357	0.0357	0.000	100	0.000	1.000
2005	Unmatched	0.0529	0.0766	-9.700		-2.230	0.026
	Matched	0.0503	0.0503	0.000	100	0.000	1.000
2007	Unmatched	0.0946	0.0782	5.800		1.520	0.128
	Matched	0.0909	0.0909	0.000	100	0.000	1.000
2008	Unmatched	0.0609	0.0798	-7.400		-1.740	0.082
	Matched	0.0617	0.0617	0.000	100	0.000	1.000

Table A4: Indicators of the covariate balancing before and after matching (concl.)

Panel B: Two-group Hotelling T-squared test

Sample	T-squared	F-test	p-value
Matched	5.534	0.138	1.000

Panel C: Pseudo R2 and test of joint sifnificance of regressors

Sample	Pseudo R2	Chi2	p-value
Unmatched	0.128	1416.95	0.000
Matched	0.003	4.91	1.000

Notes: The table reports results from the tests of matching quality described in section 4. The individual t-tests and the two-group Hotelling t-square statistic assess for mean equality of observable attributes between domestic and acquired firms in the matched sample. The Pseudo R2 of the logit on the matched data and test of joint signicance of regressors given by the Chi-square test provide evidence on the overall quality of the matching procedure.

Table A5: Effects of foreign acquisition on employment

Dependent variable:	log employment	
	(1)	(2)
Firms with initially 1 layer		
Foreign ownership	0.0790	0.1014*
	(0.0546)	(0.0548)
Industry trends	N	Y
N (obs.)	1,446	1,446
N (firms)	181	181
Firms with initially 2 layers		
Foreign ownership	0.1620***	0.1628***
	(0.0593)	(0.0597)
Industry trends	N	Y
N (obs.)	3,763	3,763
N (firms)	432	432
Firms with initially 3 layers		
Foreign ownership	0.1345***	0.1326***
	(0.0449)	(0.0443)
Industry trends	N	Y
N (obs.)	4,938	4,938
N (firms)	510	510
Firms with initially 4 layers		
Foreign ownership	0.0943	0.0904
	(0.1109)	(0.1031)
Industry trends	N	Y
N (obs.)	976	976
N (firms)	94	94

Notes: Foreign ownership status is lagged one year. All regressions include year dummies. Standard errors in parentheses clustered at firm level. *10% level, **5% level, and ***1% level.

Table A6: Effects of foreign acquisition on sales, labor productivity, hourly wage and number of layers (pooled)

	Full sample		Matched sample	
	(1)	(2)	(3)	(4)
A. Dependent variable: sales				
Foreign ownership	0.3752***	0.3771***	0.2880***	0.2887***
	(0.0452)	(0.0452)	(0.0547)	(0.0548)
Industry trends	N	Y	N	Y
N (obs.)	432,955	432,955	11,082	11,082
N (firms)	74,666	74,666	1214	1214
B. Dependent variable: labor productivity				
Foreign ownership	0.2406***	0.2440***	0.1539***	0.1549***
	(0.0380)	(0.0380)	(0.0467)	(0.0469)
Industry trends	N	Y	N	Y
N (obs.)	432,955	432,955	11,082	11,082
N (firms)	74,666	74,666	1214	1214
C. Dependent variable: hourly wage				
Foreign ownership	0.0800***	0.0808***	0.0675***	0.0659***
	(0.0116)	(0.0116)	(0.0134)	(0.0134)
Industry trends	N	Y	N	Y
N (obs.)	432,955	432,955	11,082	11,082
N (firms)	74,666	74,666	1214	1214
D. Dependent variable: number of layers				
Foreign ownership	0.0981***	0.1000***	0.1339***	0.1301***
	(0.0275)	(0.0274)	(0.0311)	(0.0307)
Industry trends	N	Y	N	Y
N (obs.)	432,955	432,955	11,082	11,082
N (firms)	74,666	74,666	1214	1214

Notes: Foreign ownership status is lagged one year. All regressions include year dummies. Standard errors in parentheses clustered at firm level. *10% level, **5% level, and *1% level.

Table A7: Summary statistics, auxiliary survey data

	Full sample			Matched sample		
	All firms	Always domestic	Acquired by foreign investors	All firms	Always domestic	Acquired by foreign investors
	(1)	(2)	(3)	(4)	(5)	(6)
Use of intranet (yes=1)	0.6987	0.6734	0.8750	0.8190	0.7634	0.8632
	(0.4588)	(0.4690)	(0.3310)	(0.3859)	(0.4276)	(0.3451)
Use of e-mail (yes=1)	0.9941	0.9933	1.0000	1.0000	1.0000	1.0000
	(0.0763)	(0.0816)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Use of extranet (yes=1)	0.4412	0.4244	0.5578	0.4905	0.4194	0.5470
	(0.4966)	(0.4943)	(0.4971)	(0.5012)	(0.4965)	(0.4999)
Use of internal networks (yes=1)	0.8946	0.8826	0.9776	0.9857	0.9677	1.0000
	(0.3071)	(0.3219)	(0.1481)	(0.1190)	(0.1778)	(0.0000)
Log sales	17.0425	16.9941	17.3791	17.3743	17.3629	17.3833
	(1.4272)	(1.4273)	(1.3820)	(1.4796)	(1.5130)	(1.4594)
Employment	377.8674	357.0394	522.8862	310.9952	288.5376	328.8462
	(817.4347)	(734.948)	(1240.308)	(333.4359)	(247.4193)	(388.6565)
Log labor productivity	11.8568	11.8376	11.9906	12.1480	12.1458	12.1497
	(1.4956)	(1.4940)	(1.5010)	(1.4151)	(1.3755)	(1.4521)
Log hourly wage	1.9207	1.8831	2.1830	2.0102	1.9903	2.0261
	(0.4590)	(0.4356)	(0.5273)	(0.3579)	(0.3163)	(0.3885)
N (obs.)	4,268	3,732	536	200	83	117
N (firms)	1,624	1,452	172	61	29	32

Notes: The table reports means and standard deviations (in parentheses) for firm-year observations with more than 10 employees over the period 2004-2009 of firms that are not foreign owned in their first year in the sample. A firm is foreign owned if foreign investors hold at least 50% of capital. Columns (1) and (4) refer to all firms, column (2) and (5), refer to firms that did not change ownership during the sample period, columns (3) and (6) refer to firms that changed to foreign ownership status only once during the sample period. Monetary variables are in 2009 prices.

Table A8: Effects of foreign acquisition on the use of intranet (matching also on intranet use prior to foreign acquisition)

Dependent variable: use of intranet	(1)	(2)
Foreign ownership	0.1398*	0.1865**
	(0.0814)	(0.0876)
Industry trends	N	Y
R^2	0.725	0.751
N (obs.)	186	186
N (firms)	49	49

Notes: Foreign ownership status is lagged one year. All regressions include year dummies. Standard errors in parentheses clustered at firm level. *10% level, **5% level, and *1% level.